

PATENT COOPERATION TREATY

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY
(PCT Rule 43bis.1)**

To: see form PCT/ISA/220

Date of mailing (day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference see form PCT/ISA/220	FOR FURTHER ACTION See paragraph 2 below
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International application No. PCT/EP2016/054210	International filing date (day/month/year) 29.02.2016	Priority date (day/month/year) 03.03.2015
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International Patent Classification (IPC) or both national classification and IPC INV. F02D41/30 F02M37/04 F02M37/08 F02D41/38 ADD. F02D41/22 F02D41/20
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Applicant ROBERT BOSCH GMBH

1. This opinion contains indications relating to the following items:


- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:  European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Fax: +31 70 340 - 3016	Date of completion of this opinion see form PCT/ISA/210	Authorized Officer Röttger, Klaus Telephone No. +31 70 340-0
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Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - the international application in the language in which it was filed.
 - a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).
2. This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. forming part of the international application as filed:
 - in the form of an Annex C/ST.25 text file.
 - on paper or in the form of an image file.
 - b. furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. furnished subsequent to the international filing date for the purposes of international search only:
 - in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
 - on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
4. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	<u>1-11</u>
	No: Claims	

Inventive step (IS)	Yes: Claims	
	No: Claims	<u>1-11</u>

Industrial applicability (IA)	Yes: Claims	<u>1-11</u>
	No: Claims	

2. Citations and explanations

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

- D1: JP H04 284155 A (AISAN IND) 8 October 1992
An automated translation of paragraphs [0029]-[0038] of document D1 is attached at the end of this communication.
- D2: DE 10 2012 223920 A1 (BOSCH GMBH ROBERT [DE]) 26 June 2014
- D3: DE 10 2009 045457 A1 (DENSO CORP [JP]) 12 May 2010
- D4: DE 10 2011 055921 A1 (HYUNDAI MOTOR CO LTD [KR]; KIA MOTORS CORP [KR]) 6 June 2012
- D5: DE 10 2013 200590 A1 (GM GLOBAL TECH OPERATIONS INC [US]) 25 July 2013
- D6: John Lepkowski: "Motor Control Sensor Feedback Circuits",
, 1 January 2003 (2003-01-01), XP055228387,
Retrieved from the Internet:
URL:<http://ww1.microchip.com/downloads/en/AppNotes/00894a.pdf>
[retrieved on 2015-11-13]

1 Independent claims

The present application does not meet the criteria of patentability, because the subject-matter of independent claims 1 and 9 does not involve an inventive step in the sense of Article 33(3) PCT.

1.1 Independent claim 1

Document D1 is regarded as being the prior art closest to the subject-matter of independent claim 1, and discloses:

Method for restoring the correct operation of a prefeed pump of a pump unit used to feed fuel, ~~preferably diesel~~, to an internal-combustion engine, the pump unit having a ~~high-pressure pump used to feed the fuel to the internal-combustion engine and said prefeed pump being able to draw the fuel from a tank before feeding same to the high-pressure pump~~ and comprising an electrical gear pump, which has a ~~pair of meshed~~

~~gears, a permanent-magnet brushless three-phase an~~ electric motor ~~used to drive the two gears~~ and an electronic pump control unit that can control said electric motor and to communicate with an engine control unit of the internal-combustion engine, the method comprising:

- measuring the phase current of the electric motor using current measurement means related to the electronic pump control unit (*by using the shunt resistor R in Fig. 2*), and
- using the engine control unit to temporarily invert the direction of rotation of the electric motor if the measured phase current exceeds a predetermined threshold current value (*the pump motor is first stopped in step 140 and then the rotation direction is inverted for a short time at step 150 after it has been detected at step 130 that the pump current has exceeded a threshold*), in order to purge the prefeed pump of any dust and/or waste in the fuel and/or of any particles caused by abrasive wear that have been deposited in ~~a pump part the pair of gears or in the axial space between said gears~~ (*see abstract: "To release medium-low degree motor lock condition happened when foreign matters are bitten in so as to enable restart-up by carrying out drive control in such a manner as rotating a motor clockwise and counterclockwise to discharge foreign matters in case foreign matters are bitten by a pump part and the like to cause a motor lock condition"*).

The subject-matter of claim 1 therefore differs from this known method in that it is applied to a different type of pump unit having a high-pressure pump used to feed the fuel to the internal-combustion engine and said prefeed pump being able to draw the fuel from a tank before feeding same to the high-pressure pump and comprising an electrical gear pump, which has a pair of meshed gears, a permanent-magnet brushless three-phase electric motor used to drive the two gears and an electronic pump control unit.

Claim 1 is therefore new.

A corresponding pumping assembly is however already known from D2 which shows a high-pressure pump ("*Hochdruckpumpe 1*") for feeding fuel to the internal combustion engine, a pre-feeding pump (35) being suited to get fuel from a tank in order to feed it to the high-pressure pump and consisting of an electric gear pump ("*Zahnradpumpe 14*"), which comprises a pair of gears ("*Innenzahnrad 56*" and "*Außenzahnrad 58*") coupled to one another, a three-phase ("*Drehstrom*") brushless ("*bürstenlos*") permanent-magnet (*see permanent magnets 51*) electric motor (17) to operate the two gears and an electronic pump control unit (*see "eine, vorzugsweise elektronische, Steuerungseinheit" in paragraph [0037]*).

The subject-matter of independent claim 1 therefore consists merely in the application of a known method to a similar, equally known pumping assembly. In D1 (see paragraph [0038]: "The kind in particular of motor used as a controlled object is not limited"), the application to different motor types has already been envisaged. Hence, the subject-matter of claim 1 cannot be attributed an inventive step.

1.2 Further independent claim 9

The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent claim 9, which therefore is also considered not inventive.

2 Dependent claims

Dependent claims 2-8, 10 and 11 do not contain any features which meet the requirements of inventive step for the following reasons:

- **Claims 2, 3:**

It is already known from D1 to stop the electric motor in step 140, to invert the direction of rotation for a predetermined time which corresponds to a predetermined number of rotations in step 150 and subsequently restart the electric motor in step 120 in the normal direction of rotation. It is common knowledge that during the start of a brushless motor the rotation speed is ramped up. Hence, the subject-matter of claims 2 and 3 cannot be considered as inventive.

- **Claims 4-6:**

The communication between the engine control unit and the pump control unit is well known in the field, see e.g. documents D3-D5 and the corresponding passages cited in the search report. The setting of a target pump speed as known from D3 (see e.g. "Solldrehgeschwindigkeit" in Fig. 2) represents only one of several straightforward possibilities from which the skilled person would select according to the circumstances to implement the method of D1 in a system according to D2.

- **Claims 7, 8, 10, 11:**

The use of inverters and half-bridges are commonly used technologies for power electronics for brushless motors, as it can e.g. be seen from D4-D6. When using one of these technologies to fill the gap provided by the teaching of D2, which simply refers to power electronics ("Leistungselektronik"), the skilled person will realise that there are only limited possibilities to position the current measuring resistor as they are e.g. described in document D6, see especially Fig. 2 and

page 4. The skilled person would subsequently select one possibility according to the circumstances. Consequently, the subject-matter of dependent claims 7, 8, 10 and 11 cannot be attributed an inventive step.

Automatic translation of paragraphs [0029]-[0038] of document D1:

[0029]Next, operation of this example is described with reference to the flow chart of Fig.4.

[0030]If the starting switch 51 is turned on at Step 100, predetermined voltage is supplied to the control part 40 and the drive circuit 45 from the power supply 50, and it will be in an operation state. And counter value n for the number of times of an inversion in the control part 40 is reset at Step 110, and it is referred to as 0. Then, at Step 120, transistor T2 of the drive circuit 45 and T3 are turned ON, and the motor 22 of the fuel pump 20 is right-rotated for a predetermined period (for example, 100 ms).

[0031]In Step 130, it is judged whether the conducting current value to the motor 22 at this time is normal. That is, since the current value and rotational torque of the motor 22 are in proportionality relation, as shown, for example in Fig.5 and 6, they judge whether it is the motor locked state by which the foreign substance D was blown between the impeller 36 and the casing 21. And when judged with a current value being normal and not being a motor locked state, it proceeds to Step 180, and when a current value is judged in size rather than a predetermined value to be a motor locked state, it proceeds to Step 140.

A6330 JP.4626491.A

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[0032]Subsequently, in Step 140, transistor T1 - T4 are turned OFF and the end motor 22 is stopped. Then, at Step 150, the inversion drive of the motor 22 is carried out for a predetermined period (for example, 100 ms) by setting transistor T1 and T4 to ON, and counter value n for the number of times of an inversion is *****ed in Step 160.

[0033]And at Step 170, it judges whether it is smaller than the number of times (Y) that counter value n was set up preliminarily, when a judgment is YES, it returns to Step 120, and it is step 200 HE **** in the case of NO. Therefore, it is right rotation of the motor 22 until counter value n becomes the predetermined number Y. -- Stop -- Reverse rotation is repeated.

[0034]If it releases that the foreign substance D bites in the meantime (motor locked state) and is judged with the current value of the motor 22 being normal at Step 130, it will result to Step 180 and counter value n will be reset by 0.

[0035]Then, at Step 190, the motor 22 is rebooted by right rotation, rotational speed are controlled by the PWM drive based on the signal SIG corresponding to the operational status of vehicles, and the motor 22 continues right rotation. and the time of carrying out the PWM drive -- X (ms) -- every -- it returns to Step 130 and checks the current value of the motor 22. In Step 190, OFF of the input of the driving stoppage of the fuel pump 20 of the signal SIG or the signal ST from the starting switch 51 will end the above-mentioned control.

[0036]On the other hand, even if it repeats reverse rotation Y times, when the current value of the motor 22 does not become normal, the energization to the motor 22 is stopped at Step 200, the warning lamp 52 is continuously turned on at Step 210, and control is ended.

[0037]Processing of the above-mentioned step 130 is equivalent to the motor locked state detection means 11, and processing of Step 140 is equivalent to the energization stop means 12. Processing of Step 120,150,170 is equivalent to the reciprocal rotation driving means 13, and processing of Step 190 is equivalent to the reboot means 14.

[0038]This invention is not limited to an above-mentioned description and the example of the figure, and can change that embodiment in the range which does not deviate from the technical idea of this invention. For example, although the thing of composition of performing detection of a motor locked state based on the conducting current to the motor 22 was shown, it is good also as composition distinguished based on the rotational speed of the motor 22, the amount of fuel discharge and discharge pressure of the pump part 32, etc. The kind in particular of motor used as a controlled object is not limited.